



CloudLab

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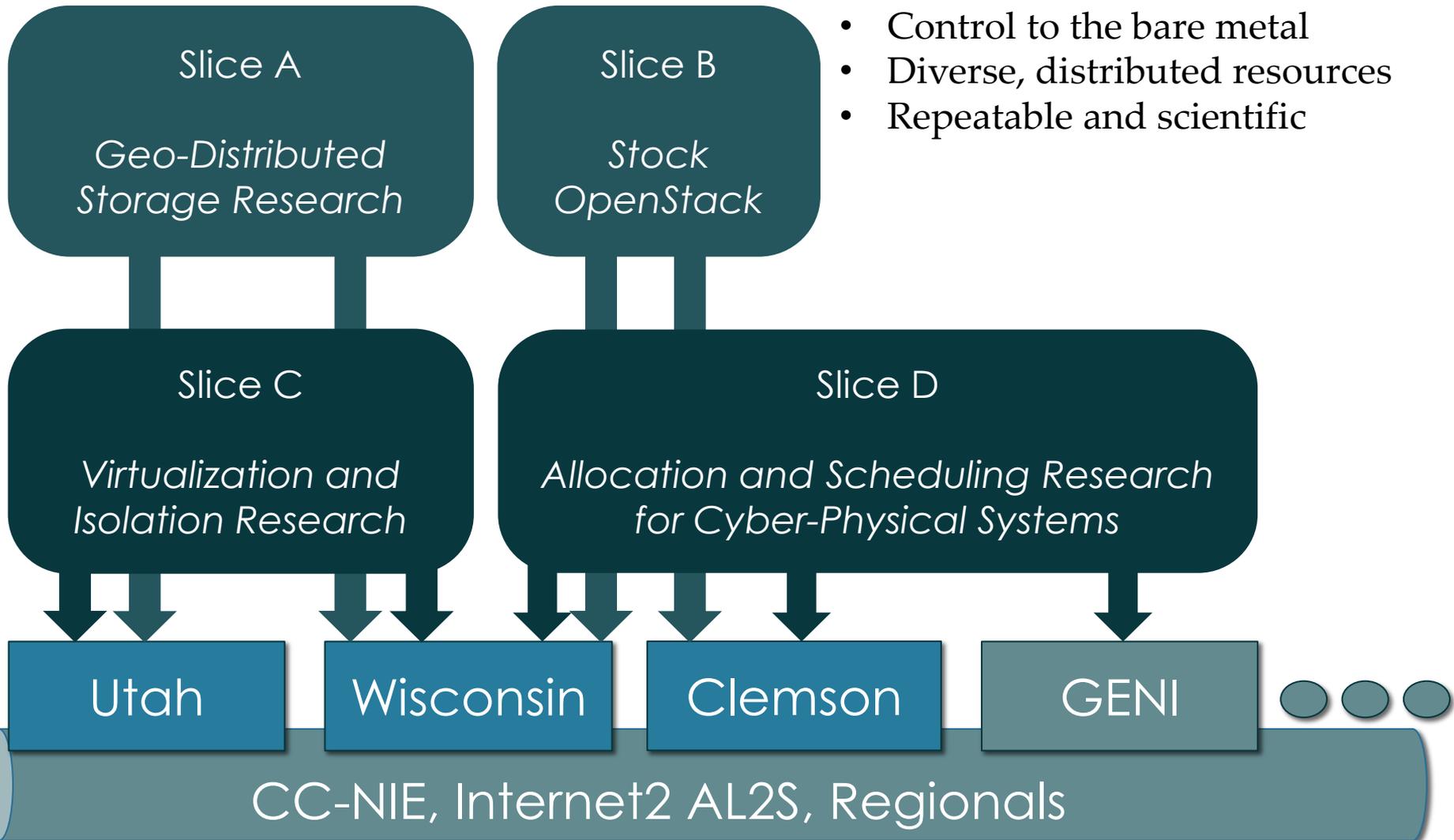
Crash Course in CloudLab

- Underneath, it's GENI
 - Same APIs, same account system
 - Even many of the same tools
 - Federated (accept each other's accounts, hardware)
- Physical isolation for compute, storage (shared net.*)
- Profiles are one of the key abstractions
 - Defines an environment – hardware (RSpec) / software (images)
 - Each “instance” of a profile is a separate physical realization
 - Provide standard environments, and a way of sharing
 - Explicit role for domain experts
- “Instantiate” a profile to make an “Experiment”
 - Lives in a GENI slice

* Can be dedicated in some cases



What Is CloudLab?





CloudLab's Hardware

One facility, one account, three locations

- About 5,000 cores each (15,000 total)
- 8-20 cores per node
- Baseline: 8GB RAM / core
- Latest virtualization hardware
- TOR / Core switching design
- 10 Gb to nodes, SDN
- 100 Gb to Internet2 AL2S
- *Partnerships with multiple vendors*

Wisconsin

- **Storage and net.**
- Per node:
 - >128 GB RAM
 - 2x1TB Disk
 - 400 GB SSD
- Clos topology
- *Cisco/HP*

Clemson

- **High-memory**
- 16 GB RAM / core
- 16 cores / node
- Bulk block store
- Net. up to 40Gb
- High capacity
- *Dell*

Utah

- **Power-efficient**
- ARM64 / x86
- Power monitors
- Flash on ARM64s
- Disk on x86
- Very dense
- *HP*



Cluster Status

Active Experiments: **107**

Utah **Up** 31%

Clemson **Up** 100% full

Wisconsin **Up** 99% full

Activity

Projects 216

Users 862

Profiles 1,459

Experiments 12,700

Federated Facilities

Emulab

Apt

Kentucky

iMinds

Utah DDC

Up

Up

Up

Up

Up



Cloudlab Users ★







CloudLab Hardware



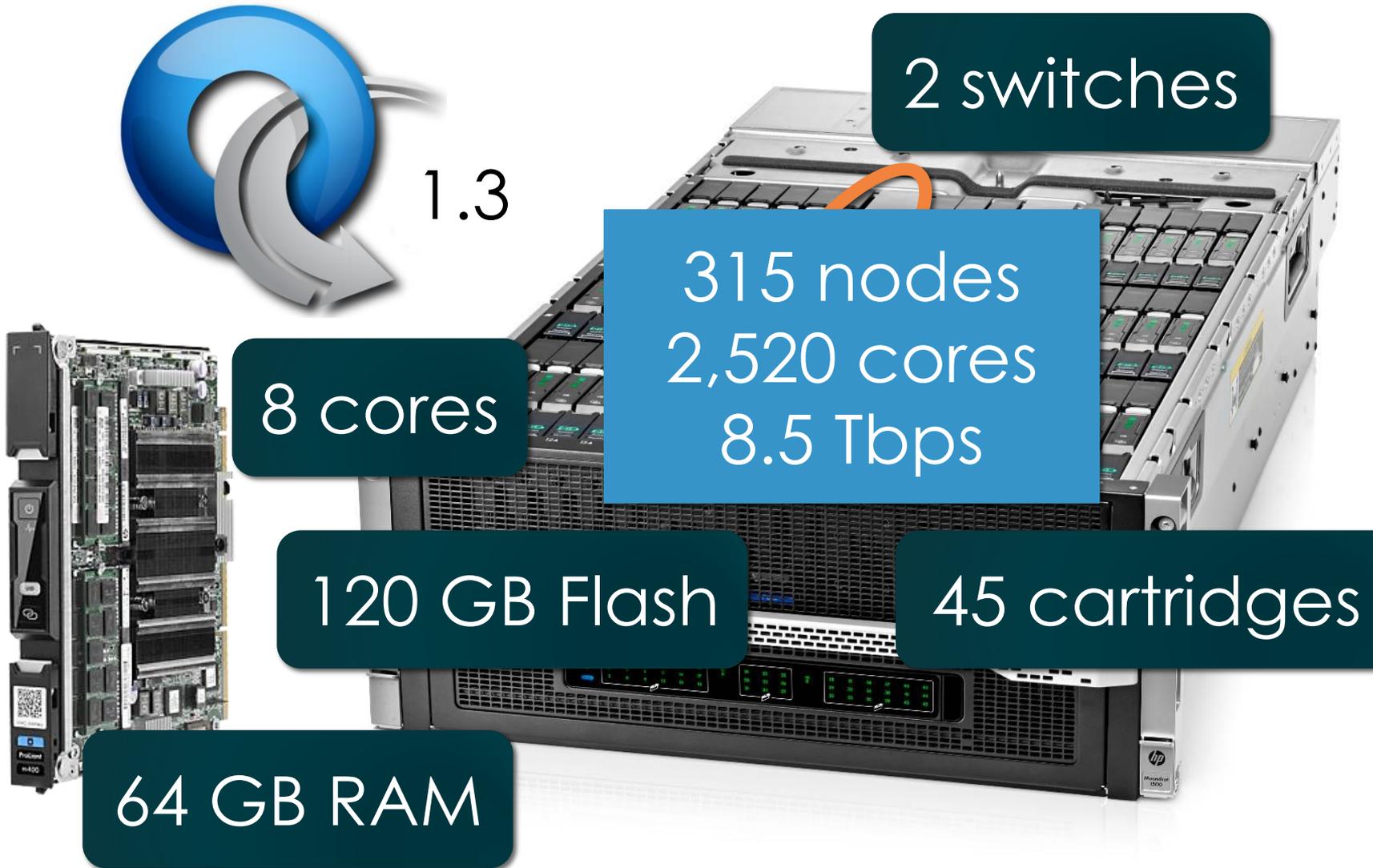


Utah/HP: Very dense





Utah/HP: Low-power ARM64



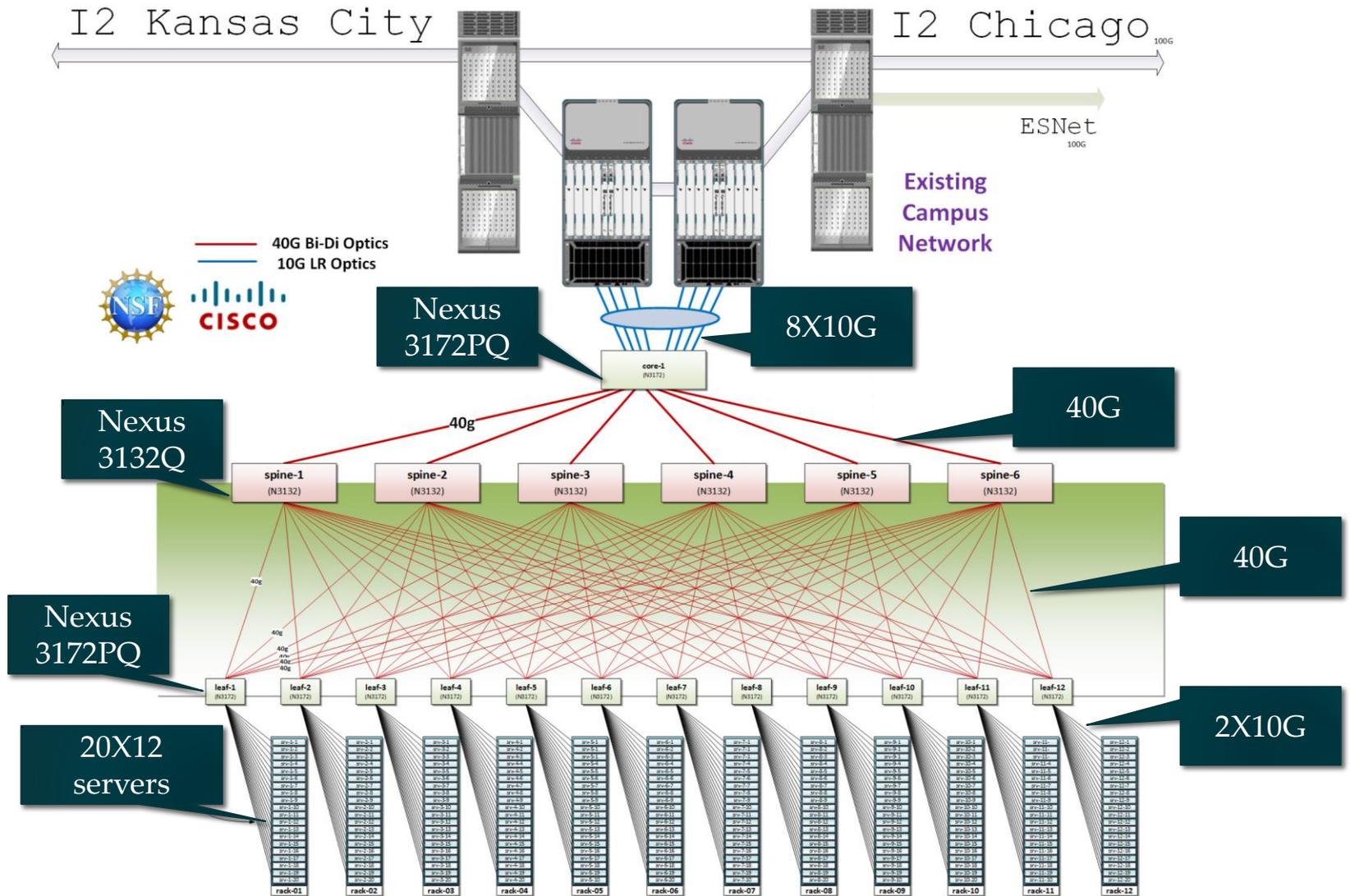


Utah - Suitable for experiments that:

- ... explore power/performance tradeoffs
- ... want instrumentation of power and temperature
- ... want large numbers of nodes and cores
- ... want to experiment with RDMA via RoCE
- ... need bare-metal control over switches
- ... need OpenFlow 1.3
- ... want tight ARM64 platform integration



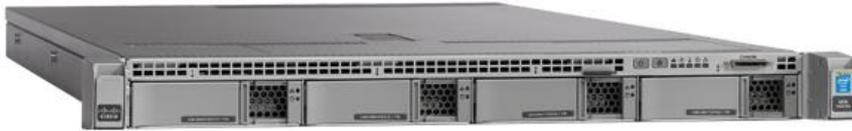
Wisconsin/Cisco





Compute and storage

90X Cisco 220 M4



10X Cisco 240 M4



- 2X 8 cores @ 2.4GHz
 - 128GB RAM
 - 1X 480GB SSD
 - 2X 1.2 TB HDD
- 1X 1TB HDD
 - 12X 3TB HDD
(donated by Seagate)

Soon: ≥ 160 additional servers; OF1.3 ToR switches (HP)

Limited number of accelerators, e.g., FPGAs, GPUs (planned)



Experiments supported

Large number of nodes/cores, and bare-metal control over nodes/switches, for sophisticated network/memory/storage research

- ... Network I/O performance, intra-cloud routing (e.g., Conga) and transport (e.g., DCTCP)
- ... Network virtualization (e.g., CloudNaaS)
- ... In-memory big data frameworks (e.g., Spark/SparkSQL/Tachyon)
- ... Cloud-scale resource management and scheduling (e.g., Mesos; Tetris)
- ... New models for Cloud storage (e.g., tiered; flat storage; IOFlow)
- ... New architectures (e.g., RAM Cloud for storage)



Clemson/Dell: High Memory, IB

20 cores/node

1 x 40 Gb IB/node

8 nodes/chassis

2*x 10 GbE OF/node

10 chassis/rack

2*x 1 GbE OF/node



256 GB RAM/node

2 x 1 TB drive/server

* 1 NIC in 1st build



Clemson - Suitable for experiments that:

- ... need large per-core memory
 - e.g., High-res media processing
 - e.g. Hadoop
 - e.g., Network Function Virtualization
- ... want to experiment with IB and/or GbE networks
 - e.g., hybrid HPC with MPI and TCP/IP
- ... need bare-metal control over switches
- ... need OpenFlow 1.3



Building Profiles





Copy an Existing Profile

The screenshot shows a web browser window at cloudlab.us. The navigation bar includes 'Home', 'Manual', 'Actions', the CloudLab logo, 'rpruser logged in', and a 'Logout' button. A green notification box states 'Your experiment is ready!' with a right-pointing arrow. Below this, the experiment details are listed: URN: urn:publicid:IDN+emulab.net+slice+rpruser-QV992, State: ready, Profile: arm64-ubuntu14, and Expires: 12-07T21:24Z (in 16 hours). At the bottom right of this box are three buttons: 'Clone' (blue), 'Extend' (green), and 'Terminate' (red). The 'Clone' button is circled in orange. Below the notification is a blue box for 'Profile Instructions' with a right-pointing arrow. At the bottom, a control bar shows 'Topology View' selected, with 'List View', 'Manifest', and 'node x' as options.

cloudlab.us

Home Manual Actions  rpruser logged in Logout

Your experiment is ready! [>](#)

URN: urn:publicid:IDN+emulab.net+slice+rpruser-QV992
State: ready
Profile: arm64-ubuntu14
Expires: 12-07T21:24Z (in 16 hours)

Clone Extend Terminate

Profile Instructions [>](#)

Topology View List View Manifest node ^x



Use a GUI (Jacks)

cloudlab.us

Topology Editor

Tidy View Delete All

Custom Type

Hardware Type

(any)

Custom Hardware

Disk Image

Ubuntu 12.04 LTS 64-bit

Custom Disk Image

Install Scripts Add

• **URL:**

ex: <http://example.com/mystuff.tai>

```
graph TD; Hub(( )) --- CC[cloud-controller]; Hub --- NN[name-node]; Hub --- W1[worker-1]; Hub --- W5[worker-5]; Hub --- W[worker]; style CC stroke:#00FF00
```



Write Python Code (geni-lib)

```
two-vm.py (~/Desktop) - VIM
import geni.rspec.pg as pg
rspec = pg.Request()

# Create XenVM nodes
node1 = pg.XenVM("node1")
node2 = pg.XenVM("node2")

# Create interfaces for each node.
iface1 = node1.addInterface("if1")
iface2 = node2.addInterface("if2")

rspec.addResource(node1)
rspec.addResource(node2)

# Create a link with the type of LAN.
link = pg.LAN("lan")

# Add both node interfaces to the link.
link.addInterface(iface1)
link.addInterface(iface2)
```



Build From Scratch

cloudlab.us

Home Manual Actions  rpruser logged in Logout

Create Profile

Name 

Project

Your rspec

Description 

Instructions 

List on the home page for anyone to view.

Who can instantiate your profile?

Anyone on the internet (guest users)

Only registered users of the website



Sign Up





Sign Up At CloudLab.us

cloudlab.us

Home Manual Sign Up Login

Start Project

Personal Information	Project Information
<input type="text" value="Username"/>	<input type="radio"/> Join Existing Project <input checked="" type="radio"/> Start New Project
<input type="text" value="Full Name"/>	<input type="text" value="Project Name"/>
<input type="text" value="Email"/>	<input type="text" value="Project Title (short sentence)"/>
<input type="text" value="Institutional Affiliation"/>	<input type="text" value="Project Page URL"/>
<input type="text" value="Please Select Country"/>	<input type="text" value="Project Description (details)"/>
<input type="text" value="Please Select State"/>	
<input type="text" value="City"/>	